

TRATAMENTO ENDOVASCULAR DE UM ANEURISMA JUSTA-RENAL COM A TÉCNICA “CHIMNEY”

ENDOASCULAR TREATMENT OF A JUXTARENAL AORTIC ANEURYSM WITH THE CHIMNEY TECHNIQUE

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RESUMO

O tratamento endovascular dos aneurismas justa-renais é um desafio complexo para o cirurgião vascular. Os autores apresentam um caso de um doente de 83 anos com um aneurisma juxta-renal de grandes dimensões tratado com uma abordagem endovascular aórtica com recurso a “chimneys” para a artéria renal esquerda e artéria mesentérica superior. Nos aneurismas juxtarenais o recurso a endopróteses fenestradas tem sido reconhecida como a opção endovascular preferível, no entanto, em casos em que o risco de rotura é considerado elevado para aguardar pela produção de um dispositivo e/ou a anatomia é desfavorável o recurso ao tratamento endovascular com “chimneys” é uma opção viável e prontamente disponível. O caso apresentado é um exemplo da aplicabilidade deste tratamento, com resultado positivo conforme demonstrado.

Palavras-chave

CH-EVAR; endoprótese Chimney; endoprótese Snorkel; Aneurisma juxta-renal; Reparação endovascular complexa; Caso clínico

ABSTRACT

Endovascular treatment of juxtarenal aortic aneurysms is a complex challenge to the vascular surgeon. We present a case of an 83 year old man with a large juxtarenal aneurysm treated with an endovascular approach with chimneys to the left renal artery and superior mesenteric artery. fenestrated aortic endovascular repair has been considered the preferred endovascular approach in juxtarenal aneurysms, however when the risk of rupture is considered high to wait for a manufactured device and/or when the anatomy is not suitable for a fenestrated repair, chimney endovascular repair is a viable and promptly available option. This case report is an example of the applicability of this treatment with a positive short-term outcome as shown here.

Keywords

CH-EVAR; Chimney grafts; Snorkel grafts; EVAR; Juxtarenal aortic aneurysm; complex endovascular repair; Case Report

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INTRODUCTION / INTRODUÇÃO:

Juxtarenal aortic aneurysms (JRAA) represent around 15% of all abdominal aortic aneurysms (AAA).¹ Endovascular repair of AAAs has become a fast growing trend in vascular surgery. However, as the anatomy of a JRAA makes infrarenal sealing of an endovascular graft not feasible, JRAAs still represent a complex challenge to the vascular surgeon.

Surgical options may include open aortic surgery with suprarenal clamping, hybrid open de-branching/endovascular surgery, fenestrated endovascular aortic repair (FEVAR) and endovascular repair with parallel stent-grafts. The latter group includes “snorkel” or “chimney” (CH-EVAR), the “periscope” and “sandwich” techniques.^{1,2}

The endovascular approach is particularly advantageous in patients with high surgical risk, like the elderly and those with multiple comorbidities.

We report a case of an 83 year old man, with an 11 cm JRAA treated successfully by CH-EVAR.

CASE REPORT / CASO CLÍNICO:

An 83 year old man was referred to our Outpatient Clinic by his regular doctor after a 10cm aortic aneurysm was found in a routine abdominal ultrasound.

The patient was asymptomatic and had a history of hypertension, hypercholesterolemia, chronic heart failure (stage II of the NYHA), chronic kidney disease with a single functioning left kidney (base creatinine: 1.83mg/dl and GFR: 33.2ml/min/1.73m²) and atrial fibrillation. He was submitted to a coronary artery *bypass* graft (CABG) with greater saphenous vein and an aortic valve replacement with a mechanical valve in 2013. His regular medication included warfarine, spirinolactone, furosemide, bisoprolol, estazolam and sublingual nitroglycerin.

The patient presented with an abdominal pulsatile and expandable mass, with a positive DeBakey sign, with good and overall symmetrical arterial pulses and no other relevant findings on physical examination. The patient was admitted straight to our Vascular Surgery ward for prompt work-up and treatment.

A thoracic, abdominal and pelvic CT angiography (CTA) showed a JRAA with an 11 cm diameter starting at the level of the left renal artery (LRA) extending until the iliac bifurcation, a LRA stenosis, occlusion of the right renal artery and celiac artery stenosis. The aneurysm had a hourglass and angulated architecture with an infrarenal sharp curvature (Figure 1).

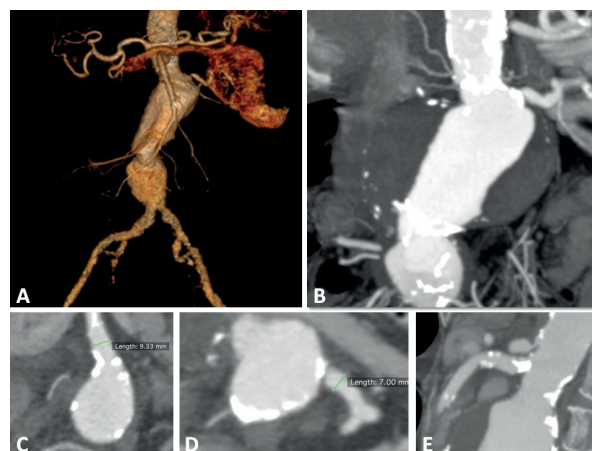


Figure 1 Pre operative contrast-enhanced CT angiography: anterior view of the juxtarenal aneurysm, showing its tortuosity and showing the LRA stenosis with a sharp downward take-off (A); cross view of the SMA (B); cross view of the LRA (C); lateral view of the aorta showing a proximal celiac artery stenosis (D).

The remaining pre-operative evaluation showed a good pulmonary reserve, with no other relevant findings.

Since the patient had a high surgical risk, the discussion remained between which endovascular approach to follow, after a board discussion about the case, a decision to proceed to an endovascular approach using the “chimney” technique was made due to the anatomy and risk of rupture of the aneurysm. The patient was scheduled for elective surgery and a CH-EVAR with “chimneys” grafts (CG) to the LRA and superior mesenteric artery (SMA) and celiac artery angioplasty with stent for concomitant occlusive disease were planned.

The procedure was performed in an angiographic suite, with the patient under general anesthesia and systemic heparinization (as needed for target ACT =200). Surgical exposure of the left and right axillary artery (LAA, RAA) and bilateral common femoral artery (LCFA, RCFA) were obtained. At the femoral arteries, purse string sutures were created to allow early declamping of the lower limbs circulation. Access of the celiac artery and SMA were planned through the right axillary artery and the LRA through the left axillary artery.

The first step of the procedure was catheterization of the celiac artery and treatment with angioplasty and placement of a balloon-expandable stent (Hippocampus® 6x20mm Medtronic®, Minneapolis, Minn). Afterwards sequential catheterization and positioning of a self-expanding covered stent (Viabahn® Gore®, Flagstaff, AZ) for the CG’s was performed in the SMA and LRA respectively. Due to difficult catheterization of the LRA and inability to progress a sheath over a stiff guidewire (Rosen®, COOK Medical®, Bloomington, Ind) a short covered balloon-expandable stent (Advanta V12® 6x22mm, Atrium Medical Corporation®, Hudson, NH)



was deployed at the ostium, facilitating access to the LRA and parking of the CG.

Through the RCFA a Zenith graft (COOK Medical®, Bloomington, Ind; main body 32x128mm;) was positioned in the abdominal aorta, aligned with the lower border of the celiac artery. Then the CG were sequentially deployed (SMA and LRA). During the release Viabahn® stent-graft in the SMA, the sheath was not sufficiently pulled back which caused the Viabahn® to be partially opened and proximally stuck inside it. With mobilization of the sheath, the stent graft was displaced from the SMA and both were pulled together to the RAA, without losing the guide-wire placed at the SMA. The Viabahn® was then partially externalized and clamped, allowing access to be regained to the SMA with introduction of a new sheath (figure 2F) and continue the procedure. A new Viabahn® (8x100mm) was deployed at the SMA and relined with a self-expanding stent (S.M.A.R.T.® flex 8x60mm, Cordis®, Fremont, CA) to prevent compression of the CG by the aortic endograft. Similar steps were repeated for the LRA CG (Viabahn® 6x100mm and relining stent (S.M.A.R.T.® flex 7x60mm, Cordis®, Fremont, CA)). A selective angiogram was performed after completion of each CG and confirmed adequate positioning and flow on the target vessel (Figure 2A, B, C).

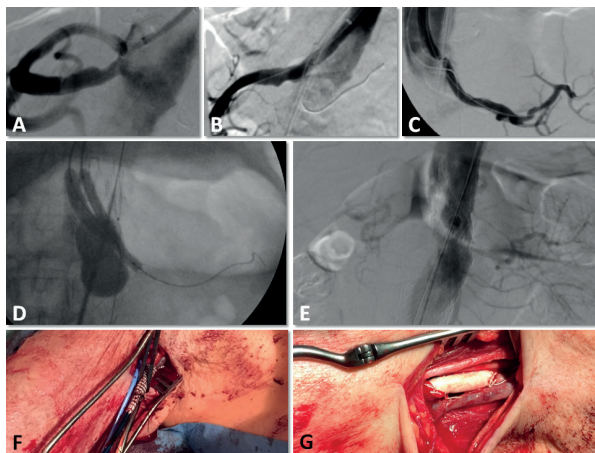


Figure 2 Intra operative angiographies: Celiac artery angiogram after stent placement (A); SMA chimney angiogram (B); LRA chimney angiogram (C); Kissing balloon technique applied to the aortic endograft and chimneys (D); Control angiography showing a small "low-flow" type 1A endoleak (E); Retrieval of the displaced Viabahn® via RAA and sheath introduction through the same Viabahn® (F) Reconstruction with an interposition PTFE of the injured RAA (G).

The bifurcated graft was then deployed at the same time as the CGs were proximally pulled with inflated balloons to achieve a better alignment between the CG's and the aortic endograft. After deployment of the bifurcated aortic graft, a kissing balloon technique was applied by simultaneous chimney and aortic graft balloon inflation and pulling in order to seal the "gutters" correctly (Figure 2D). Finally

the iliac limbs were deployed (left limb: Zenith Spiral-Z 16-74mm; right limb: Zenith Spiral-Z 20-74mm, COOK Medical®, Bloomington, Ind).

The completion angiogram showed correct exclusion of the whole aneurysm with patency of both CG, and hypogastric arteries. However, the celiac artery stent had been dislodged and parked inside the aortic main graft and a small and low-flow type IA endoleak was observed next to the renal chimney "gutter" (Figure 2E), which was managed conservatively.

Complete removal of the externalized Viabahn® at RAA was not possible due to significant resistance on pullback, so a surgical reconstruction of the artery was performed with partial resection of the Viabahn® and interposition of a 6 mm PTFE graft, englobing the remaining Viabahn® on the proximal anastomosis (figure 2G).

The post operative recovery was complicated by an acute renal failure (AKIN III), which was medically treated without need of dialysis, with recovery of preoperative renal function, and by a urinary tract infection by *Proteus mirabilis* which was treated with IV antibiotics.

A control CTA performed at 12 days post-operatively showed correct aneurysm exclusion, CG patency and no endoleaks (Figure 3). The stainless steel stent initially placed in the celiac artery remained in the same position as observed inside the main aortic graft.

The patient was discharged on the 18th day after surgery, clinically well, and is currently alive and well, 4 months after surgery.

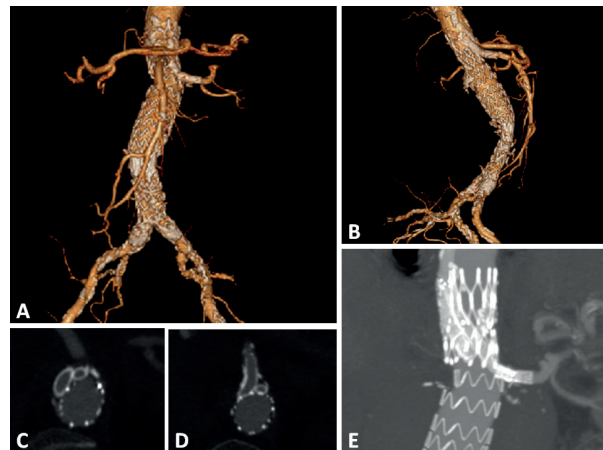


Figure 3 Post-operative contrast enhanced 3D CT angiography: Anterior (A) and lateral view (B) showing no endoleaks or chimney "crushing". Post-operative contrast enhanced CT angiography: cross view showing aortic endograft and both chimneys (C); cross view showing SMA chimney (D); anterior view showing correct aneurysm exclusion and LRA chimney (E).

DISCUSSION / COMENTÁRIOS:

Open aortic surgery still remains the gold standard for the treatment of JRAs.¹ However, patients with a higher surgical risk, may benefit from an endovascular treatment option. FEVAR has gained acceptance throughout Europe and the United States and is now considered an alternative option, especially for unfit patients.^{1,3} Recently, selected high-volume centers have published their experience of FEVAR as the first-line treatment for all patients with a JRA reporting excellent high technical success, low operative mortality rates and good mid-term durability.³ Chimney and snorkel techniques were initially described by *Greenberg* et al as bailout procedure when aortic branches were covered by an endovascular aortic graft during endovascular aortic repairs⁴, but have also been described as an alternative option for JRAA^{1,2,5}, specially in centers where FEVAR was not available.⁵ To date, no randomised trials comparing these different treatment modalities have been published. A selection bias is commonly recognized in the available literature, with younger and healthier patients treated by an open approach and endovascular techniques reserved for older and sicker patients.¹ *Katsagiris* et al¹ conducted a review of the literature reporting FEVAR, CH-EVAR and open surgical treatment of JRAA and showed similar operative mortality between the approaches and favourable comparison for FEVAR in terms of morbidity. CH-EVAR was associated with higher incidences of endoleak IA and ischemic stroke rates and the authors concluded that CH-EVAR should be reserved for acute patients and elective patients who are poor candidates for open surgery or FEVAR.¹

Although off-the-shelf fenestrated grafts have been documented, these are not widely accessible,² and usually FEVAR implies a custom-made fenestrated graft to be manufactured, which take at least 4 to 6 weeks.^{1,2} Anatomic restrictions also exist for FEVAR: heavily angulated aneurysms (angulations over 45°) and sharp lower renal and visceral artery take-offs are considered contra-indications.²

CH-EVAR usually implies an axillary approach, which increases the risk of neurological events, such as strokes¹, in patients with highly calcified and tortuous aortic arch and supra-aortic vessels.^{1,2,6} Patients with CABG involving the internal mammary artery (IMA) should be considered contraindicated for an axillary access, as advancing a sheath through the subclavian artery may temporarily occlude the IMA, leading to myocardial ischaemia.⁶ However, in such cases which may preclude antegrade catheterization, *Lachat* et al described the "Lift Technique" which is feasible and may be used appropriately in these cases.^{6,7}

As CH-EVAR is a relatively recent technique,³ with a low number of cases reported,¹ and no specifically grafts and materials designed for it, some aspects of the technique are still widely controversial.^{2,5,8}

A higher incidence of type I *endoleaks* has been documented in patients treated with CH-EVAR.^{1,2} These *endoleaks* tend to develop in the unavoidable "gutters" which are created between the CG, the main aortic graft and the aortic wall itself. It has been postulated that better sealing is obtained with an overlap of the CG against the main aortic graft of at least 20mm, a graft oversizing of 20-30% and simultaneous inflation and "pulling" of the grafts in order to align and seal the "gutters" correctly.^{2,5} However, there is still some controversy regarding the use of either balloon or self-expandable CGs, which aortic graft and what sequence of deployment to use.^{2,5,7}

In our center open surgery is considered the first-line treatment for JRAA in patients considered fit for surgery and FEVAR the first option in high-risk patients. Our patient was an 83 year old man, with multiple comorbidities and considered unfit for open surgery. As the aneurysm had a diameter of 11cm, we believed that the risk of rupture was high and precluded waiting for the manufacture of a custom-made fenestrated graft. Anatomical constraints also existed, mainly a significant angulation between the para-renal aorta and the aortic aneurism and a downward take-off and ostial stenosis of the LRA. The patient's aortic arch and supra-aortic vessels were also favourable for an axillary access.

The complications that occurred in the reported procedure show that CH-EVAR is a technical demanding and complex procedure. Mobilization of a chimney-graft during deployment was undoubtedly a technical error that was also favoured by the low visibility of an expanded Viabahn® in full lateral view and emphasises the need of high quality image systems to perform safely advanced aortic procedures. Careful planning and multiple bail-out options, including a large stock of inhouse stents and catheters, are also needed to obtain a high technical success.

CONCLUSION / CONCLUSÃO:

CH-EVAR seems to be an appropriate and valid therapeutic option for the treatment of patients with JRAA who are poor candidates for open surgery and FEVAR.^{1,5,9} Patients who are unfit for open surgery, who have a high risk of aneurysm rupture seem to be the best candidates.^{1,2,5,7} Our patient fit this description and was treated successfully with CH-EVAR, with favourable outcome at 4 months of *follow-up*.



CONSENT/ CONSENTIMENTO INFORMADO:

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

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CONFLICT OF INTEREST STATEMENT/ CONFLITO DE INTERESSES:

None

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